NEW GOLD RAINY RIVER MINE
APPENDIX T
PAG COVER TRIAL FACTUAL REPORT 2019

O'Kane Consultants
Integrated Mine Waste Management and Closure Services
Specialists in Geochemistry and Unsaturated Zone Hydrology

O'Kane Consultants Inc.
405 - 100 Centre Street NW
Calgary, AB T2E 7W6
Canada
T: (403) 215 3873 F: (403) 250 5330
www.okc-sk.com

Memorandum

To:	Sylvie St. Jean – Environmental Manager, New Gold Inc.
From:	Graham Hay, Jr. Engineer
Cc:	Garnet Cornell – New Gold Denise Chapman – O'Kane Consultants Inc.
Our ref:	1003-08-005
Date:	March 12, 2019
Re:	**Rainy River Cover System Field Trial – 2017 – 2019 Factual Data Report**

New Gold Inc. (New Gold) retained the services of O'Kane Consultants Inc. (OKC) to provide engineering and field support for development, instrumentation and performance monitoring of the potentially acid generating (PAG) mine rock cover system field trial at New Golds' Rainy River Mine. This memorandum provides a summary of field data collected from the cover system field trial between October 2017 and February 2019.

PAG Cover System Trials Background:

The PAG cover system field trial consists of two instrumented cover systems which were constructed in October 2017. Trial #1 consists of 0.5 m compacted Brenna clay (CBC), 0.75 m non-compacted clay overburden, and 0.25 m topsoil. Trial #2 consists of 0.5 m CBC and 1 m non-compacted clay overburden. The constructed field trial has an approximate area of 65 m x 100 m with a 1 to 2% sloping plateau of ~3,000 m^2. The main objectives of the cover systems are to:

- Evaluate overburden clay as cover material for mitigation of oxygen ingress during stockpile construction (operations);
- Evaluate overburden clay as a compacted layer within the closure cover system for mitigation of oxygen ingress and net percolation (closure); and
- Develop conceptual models of performance for the cover system field trial area through examining changes in *in situ* gas concentrations after cover system placement and water balances (e.g., precipitation, runoff, evaporation, water storage, etc.).

Each field trial configuration was outfitted with two instrumentation nests (primary and secondary). A meteorological station was installed on Trial #2 to collect local precipitation and net radiation data on the plateau of the trial. *In situ* monitoring instrumentation installed at each field trial includes:

- Eleven (11) matrix suction sensors (CSI 229) to measure suction and *in situ* soil temperature;
- Fourteen (14) water content sensors (CS 616) to measure *in situ* volumetric water content; and
- Six (6) oxygen sensors (SO 110) to measure differential oxygen concentrations above and below the CBC.

Automated data collection has been on-going since commissioning of the data acquisition system (DAS) in June 2018.

***In Situ* Instrumentation Data:**

Instrumentation data obtained from each cover system includes *in situ* volumetric water content and soil temperature throughout the cover system profile, and oxygen concentrations above and below the CBC. This data can be further analysed to investigate the performance of each cover system. This section presents the results of the data analysis, while data measurements obtained directly from *in situ* instrumentation are presented in Attachment A. The top of each cover system was selected as origin datum for all instrumentation depths.

Volumetric Water Content:

Volumetric water content was measured throughout the profile of each cover system to observe changes in the degree of saturation of the CBC. In order to successfully mitigate the ingress of oxygen into the underlying waste rock, the CBC must remain at / near saturated levels. As the degree of saturation exceeds 80%, the diffusion coefficient decreases by several orders of magnitude. A general rule of thumb indicates that maintaining a consistent degree of saturation of 85% or greater within a compacted clay layer will effectively limit the amount of oxygen movement by diffusion[1]. Figures 1 through 4 present the observed change in the degree of saturation with time through the cover system profiles. Table 1 highlights the key findings of saturation levels of the CBC

Table 1: Degree of saturation of the CBC.

	Degree of Saturation		
	Maximum	**Minimum**	**Average**
Trial #1 Primary Nest	100%	92%	96%
Trial #1 Secondary Nest	99%	93%	96%
Trial #2 Primary Nest	100%	83%	96%
Trial #2 Secondary Nest	99%	79%	92%

[1] Aachib, M., Mbonimpa, M., and M. Aubertin. 2004. Measurement and Prediction of the Oxygen Diffusion Coefficient in Unsaturated Media, with Applications to Soil Covers. Water, Air, and Soil Pollution 156: 163–193, 2004.

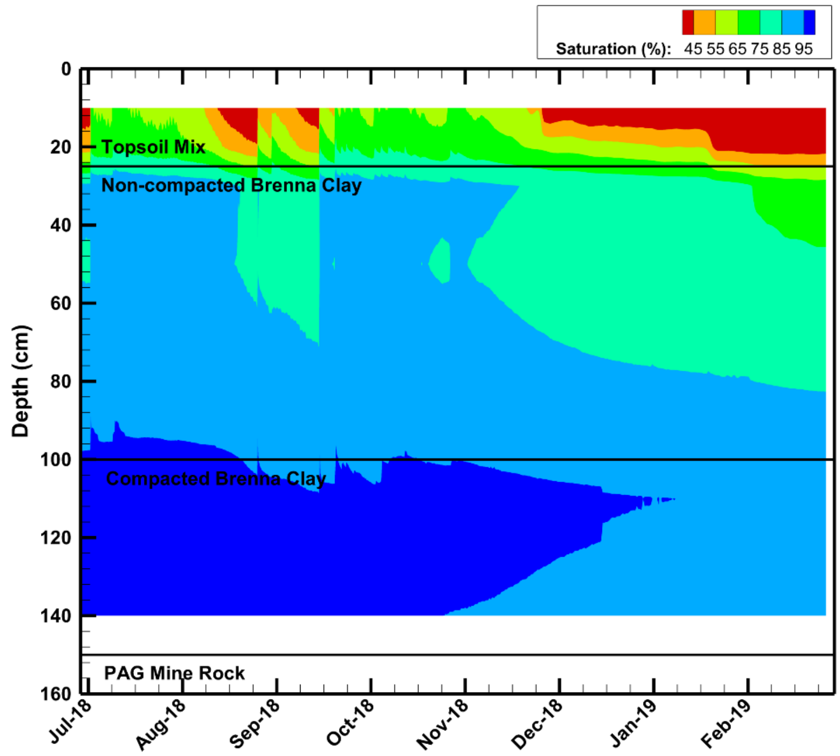

Figure 1: Change in degree of saturation at Trial #1 Primary Nest.

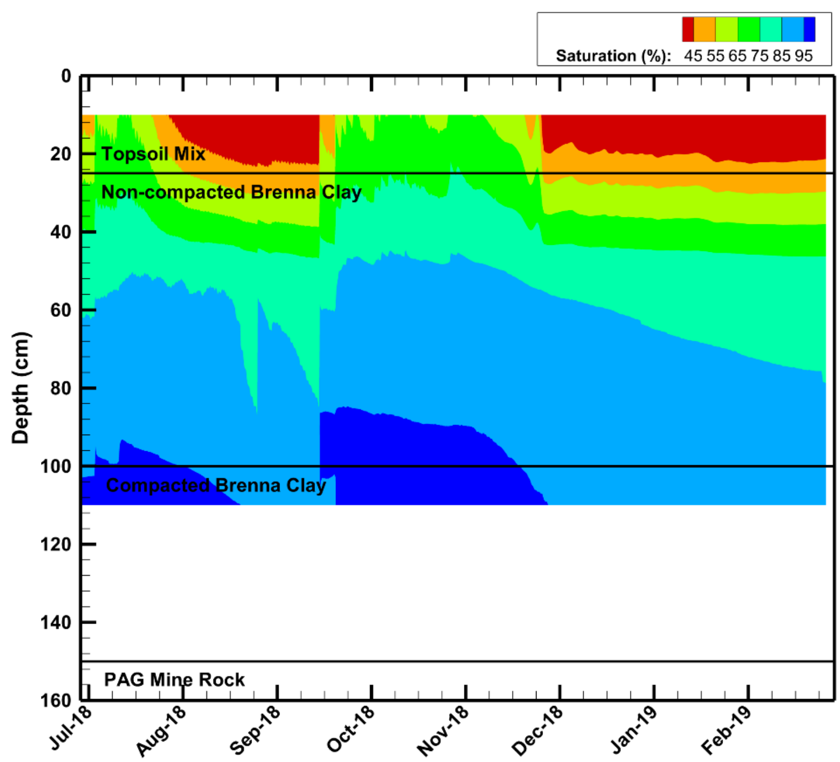

Figure 2: Change in degree of saturation at Trial #1 Secondary Nest.

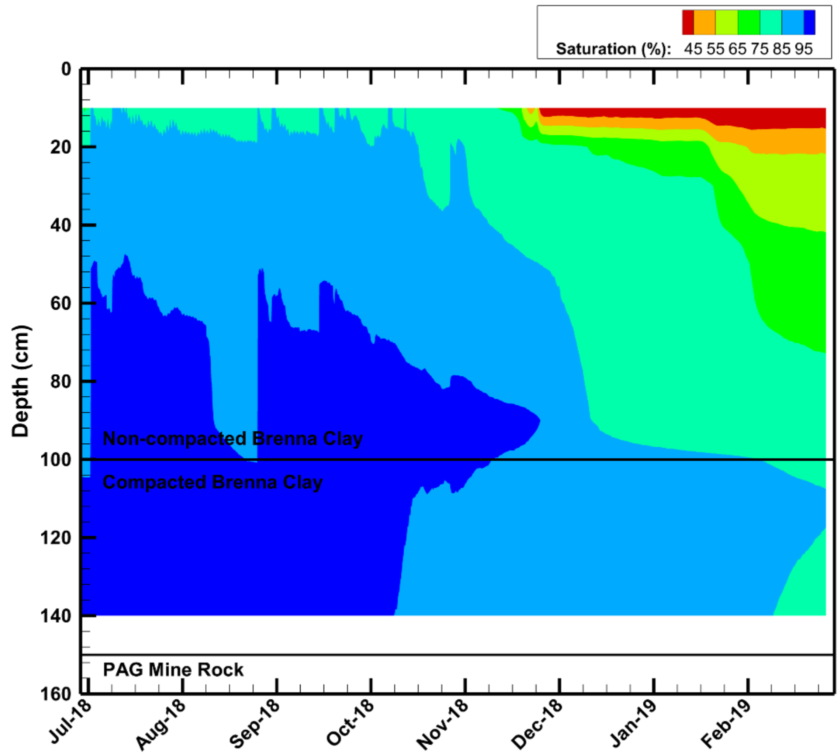

Figure 3: Change in degree of saturation at Trial #2 Primary Nest.

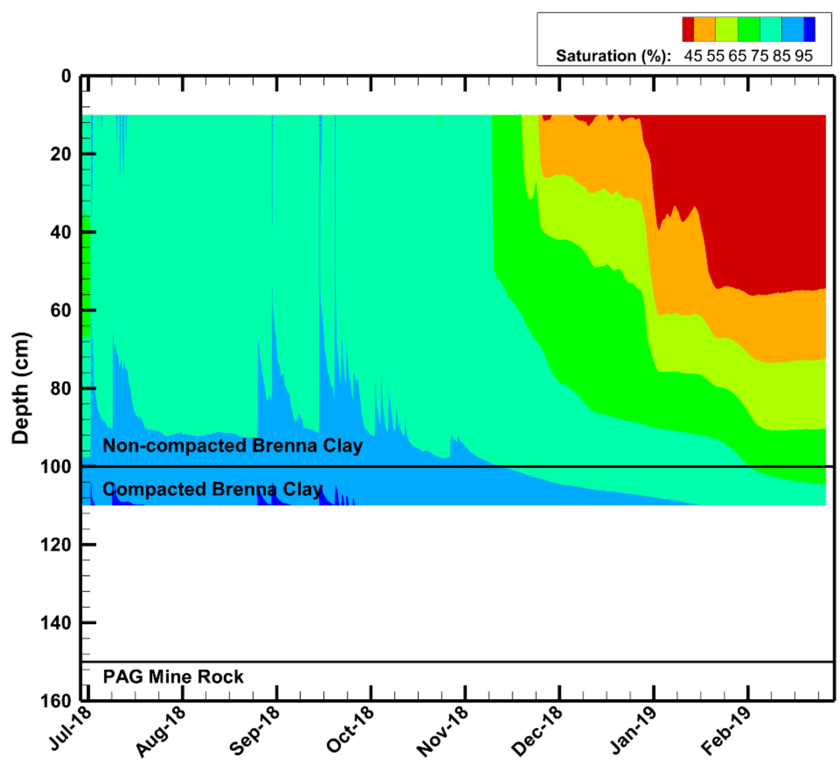

Figure 4: Change in degree of saturation at Trial #2 Secondary Nest.

In Situ Soil Temperature:

In situ soil temperature was monitored over the entire cover system of Trial #1 and Trail #2. *In situ* soil temperature is monitored to determine if the CBC undergoes freeze-thaw cycling. The biggest implication of a freeze-thaw cycle on the CBC is potential changes to physical characteristics (e.g., altering the hydraulic conductivity or moisture retention causing how the degree of saturation is managed. Freezing temperatures were observed in both cover systems starting November 25, 2018. Currently, based on *in situ* temperature measurements presented in Attachment A, the maximum freezing depth is 30 cm and 110 cm for Trial #1 and Trial #2, respectively. The large difference between the observed freezing regime is attributed to the deeper snow pack on Trial #1 (see snow survey for details). The deep snow pack provided an insulating layer between the cover system and ambient air temperature which limits the depth of freezing in the cover system. While Trial #2 had little snow pack (i.e., less insulation) this resulted in the CBC freezing to a greater depth. Figures 5 through 8 illustrate the change in *in situ* soil temperature with time through the trial profiles.

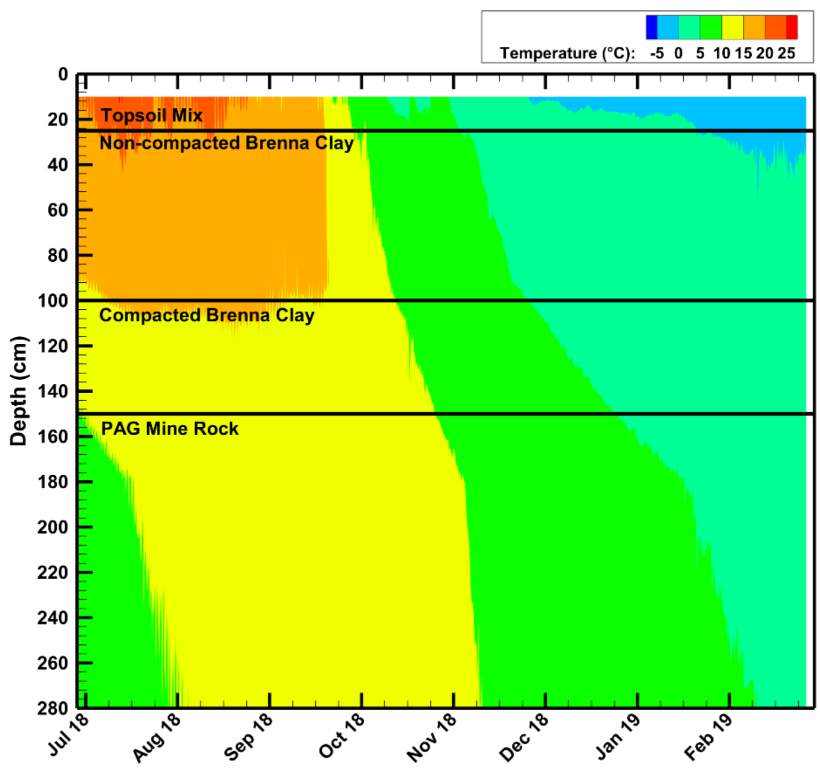

Figure 5: *In situ* soil temperature profile measured at Trial #1 Primary Nest.

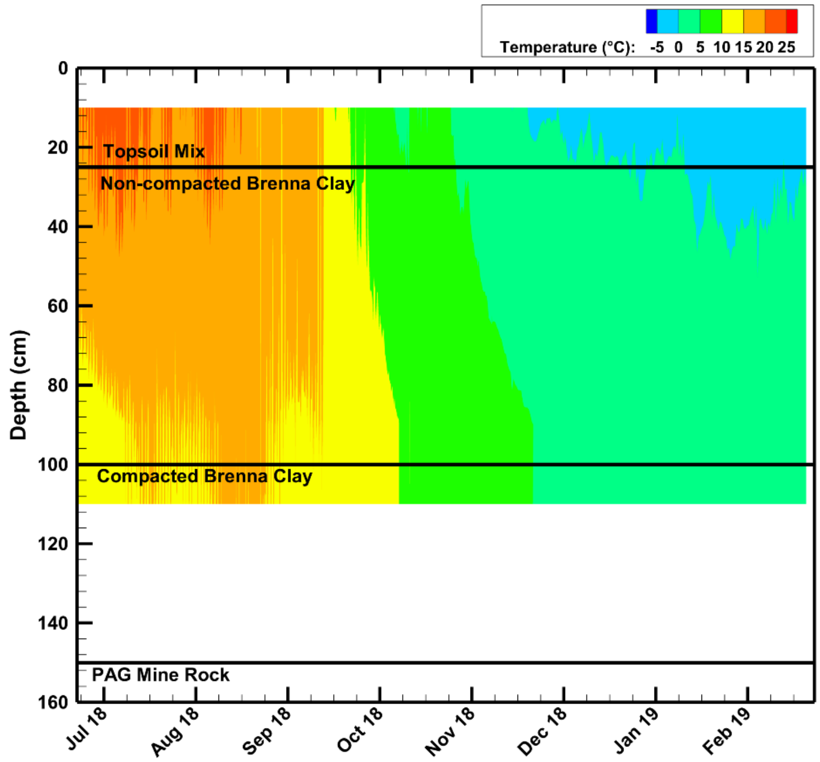

Figure 6: *In situ* soil temperature profile measured at Trial #1 Secondary Nest.

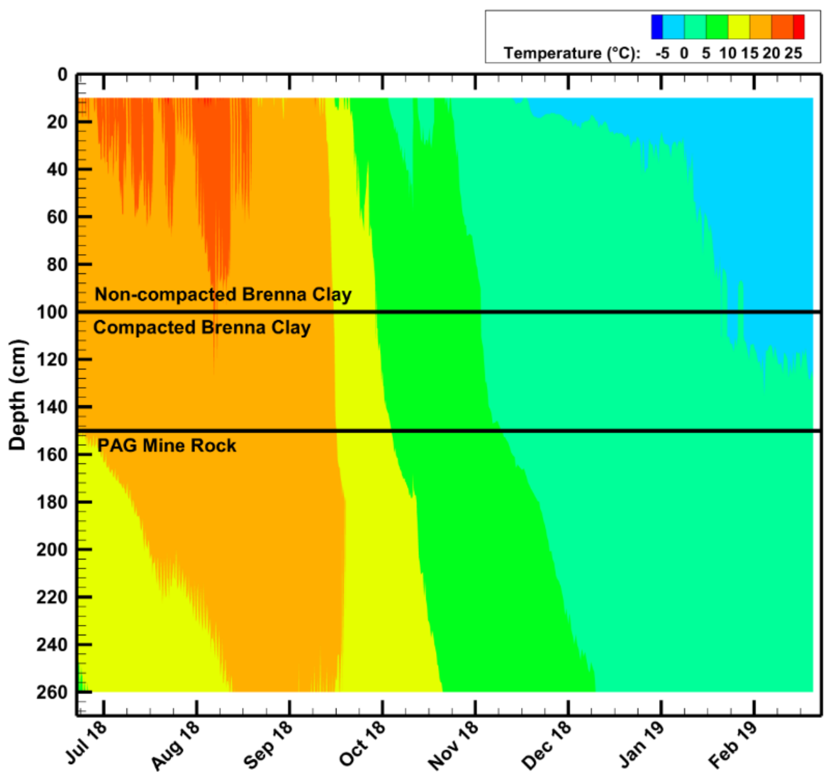

Figure 7: *In situ* soil temperature profile measured at Trial #2 Primary Nest.

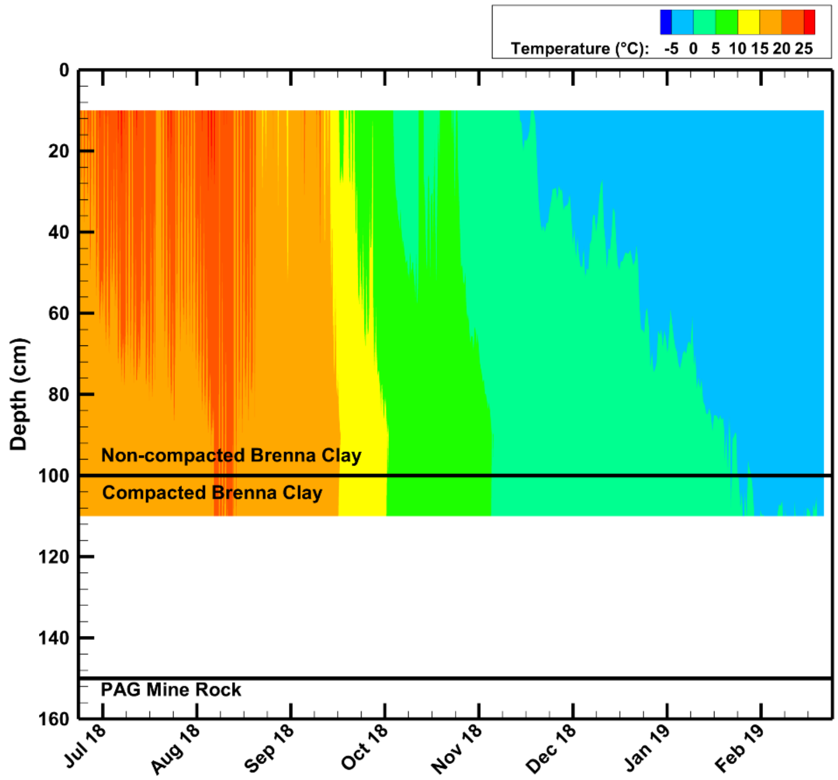

Figure 8: *In situ* soil temperature profile measured at Trial #2 Secondary Nest.

Oxygen Concentration:

Oxygen sensors were placed in the underlying waste rock and directly above the CBC layer to observe the consumption and ingress of oxygen. Prior to installation of the automated DAS, manual voltage measurements were taken periodically by New Gold personnel. Figure 9 shows observed oxygen concentrations below the CBC layer at Trial #1 Primary Nest. Oxygen concentrations in the other instrumented nests showed similar trends as shown in Figure 9. Oxygen concentrations are presented in Attachment A.

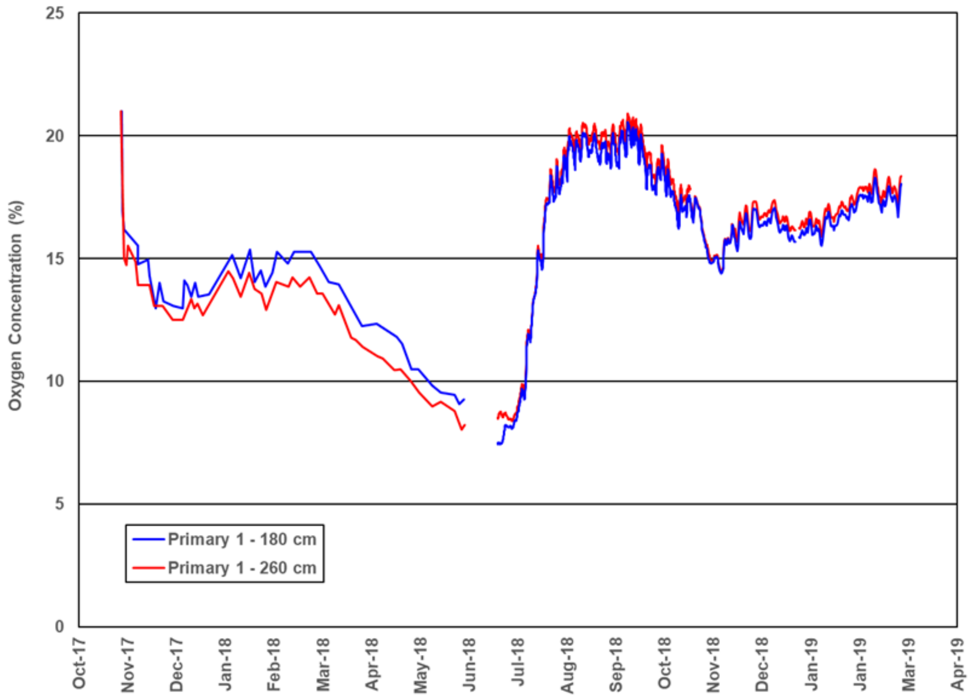

Figure 9: Oxygen concentration in waste rock below CBC layer at Trial #1 Primary Nest.

Manual Oxygen Sampling:

On November 12, 2018, OKC personnel installed ten manual gas sampling stations into the waste rock to verify measurements of the *in situ* oxygen sensors. Table 2 presents the results of oxygen concentrations collected from gas sampling. Some stations measured atmospheric oxygen concentrations immediately after installation due to the bentonite chip not yet moisturizing and sealing the hole. The oxygen concentration at Station TP1-8 measured atmospheric on March 4, 2019 and is thought not to be fully sealed. Additional benitoite will be added during spring in attempts to seal the station.

Table 2: Oxygen concentrations from manual sampling.

Station ID	O_2 (Nov. 13, 2018) (%)	O_2 (Nov. 14, 2018) (%)	O_2 (March 4, 2019) (%)
TP1-1	15.3	15.0	17.6
TP2-2	20.5	20.9	17.8
TP1-3	20.5	20.9	17.2
TP2-4	20.5	20.8	19.4
TP2-5	16.4	16.0	17.9
TP1-6	20.0	20.9	17.2
TP2-7	20.9	20.9	19.1
TP1-8	16.5	19.3	20.9
TP1-9	15.6	15.1	17.3
TP2-10	15.6	15.4	17.8

Snow Survey:

On March 4, 2019, a snow survey was conducted by OKC personnel to measure the depth of the snow pack on each cover system field trial. The trial was split into three transects (one running north to south on each trial and one running east to west across the entire trial). Survey locations and corresponding snow pack depths are illustrated in Figure 10.

Overall, Trial #1 observed a much greater snow pack on the plateau. This is mainly due to the tall vegetation acting as a snow catch on Trial #1 as compared to the bare surface of Trial #2. The large snow packs found on the east and southeast slopes can be attributed to snow blowing off the bare plateau and accumulating on the side slopes.

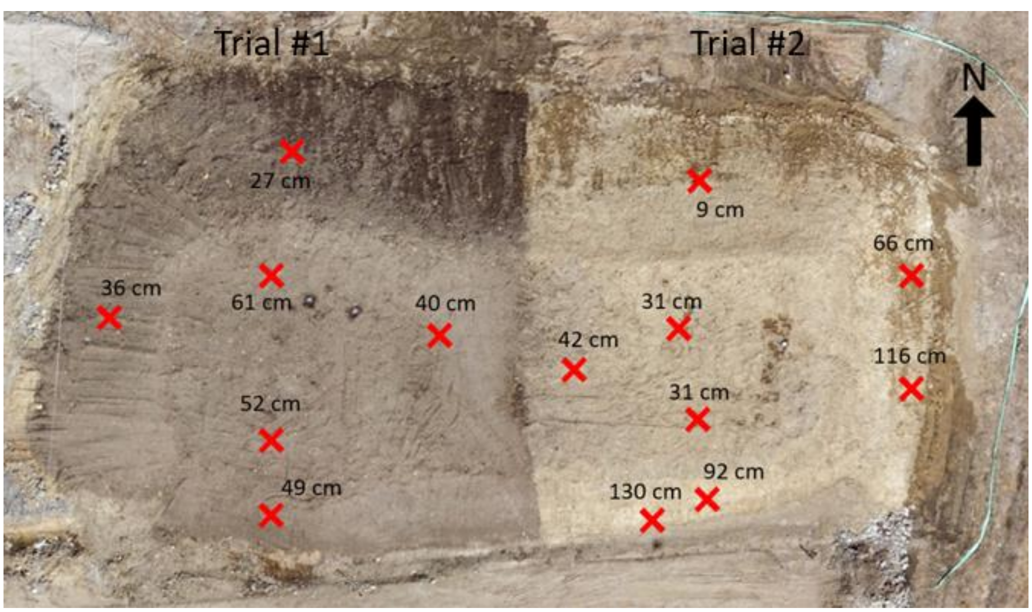

Figure 10: Snow survey locations and snow pack depths.

Summary:

The on-going monitoring of the cover system field trial will provide opportunities to understand the behavior and performance of each cover system and to evaluate the cover systems ability to mitigate the ingress of oxygen. Based on the above data analysis, the following points can be summarized:

- On average, the degree of saturation of the CBC layer is 96%.
- The freezing regime reached a depth of 30 cm and 110 cm on Trial #1 and Trial #2, respectively. This difference is due to the deeper snow pack on Trial #1 providing insulation from the ambient temperatures.
- The snow pack on Trial #1 was regularly consistent having an average depth of approximately 44 cm on the plateau and slopes. Trial #2 experienced limited snow on the plateau and a large snow pack on the south and southeast slopes. Vegetation on the Trial #1 provided a snow catchment, while snow on Trial #2 was exposed to wind gusts which allowed for snow to drift from the plateau to the side slopes.
- It is recommended that instrumentation monitoring, and manual gas sampling continue through 2019, including submission of quarterly factual data reports to New Gold in the form of PowerPoint presentations.

Closure:

We trust information provided in this memorandum is satisfactory for your requirements. Please do not hesitate to contact me at (403) 862-7711 or ghay@okc-sk.com should you have any questions or comments.

Attachment A: **Instrumentation Data**

Attachment A:

Instrumentation Data

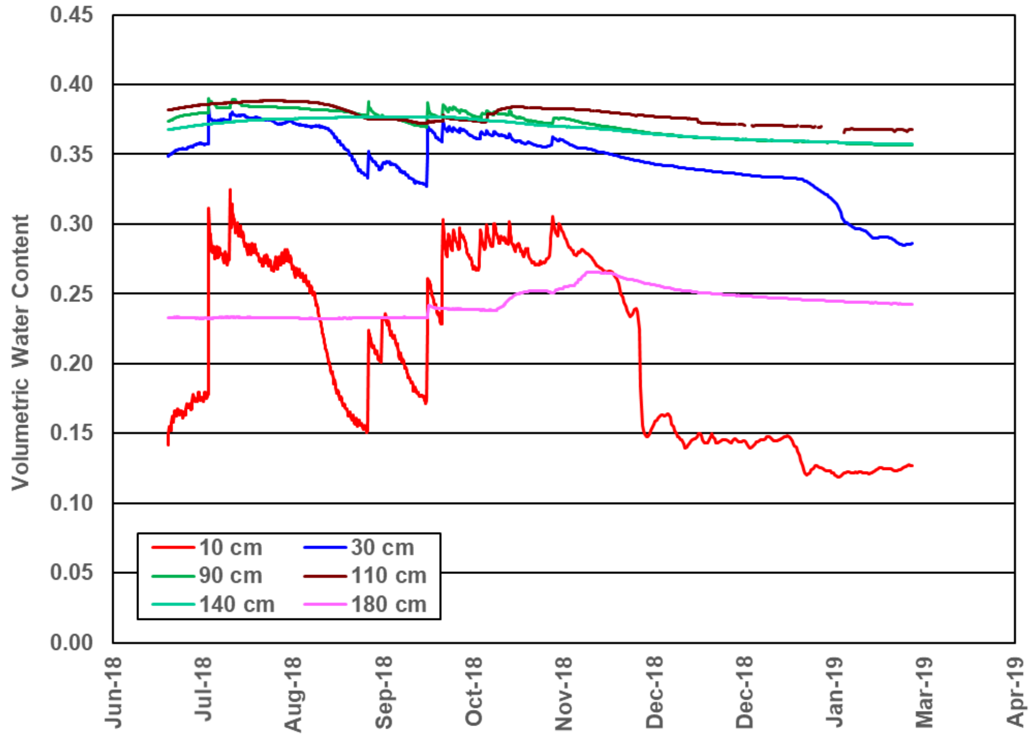

Figure A1: Volumetric water content at Trial #1 Primary Nest.

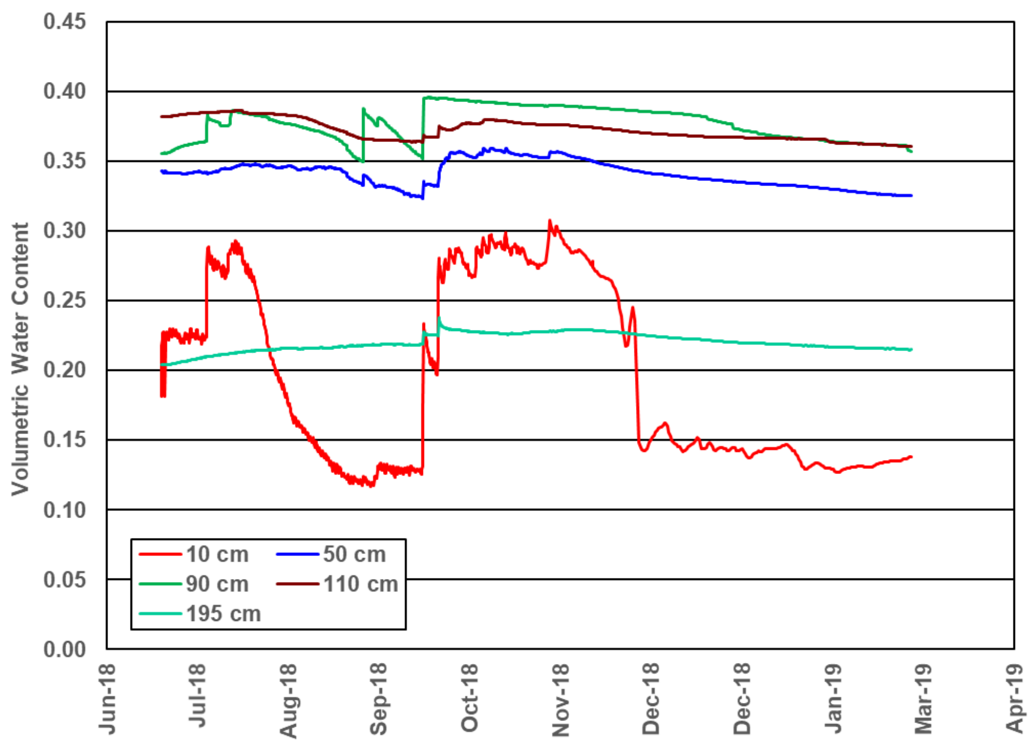

Figure A2: Volumetric water content at Trial #1 Secondary Nest.

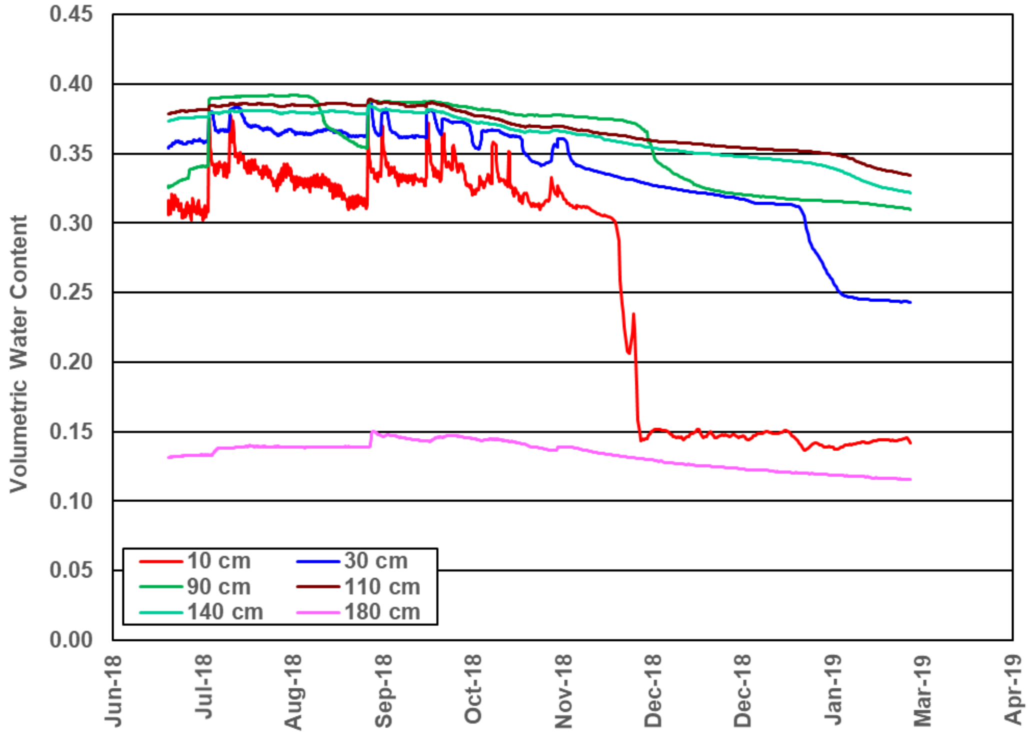

Figure A3: Volumetric water content at Trial #2 Primary Nest.

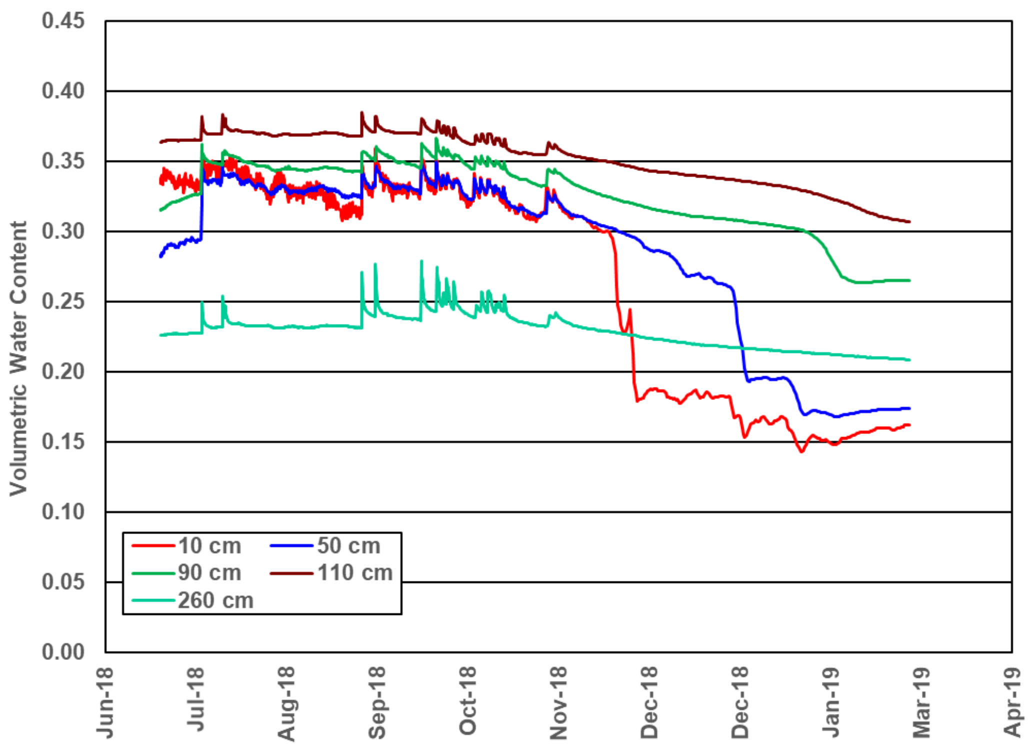

Figure A4: Volumetric water content at Trial #2 Secondary Nest.

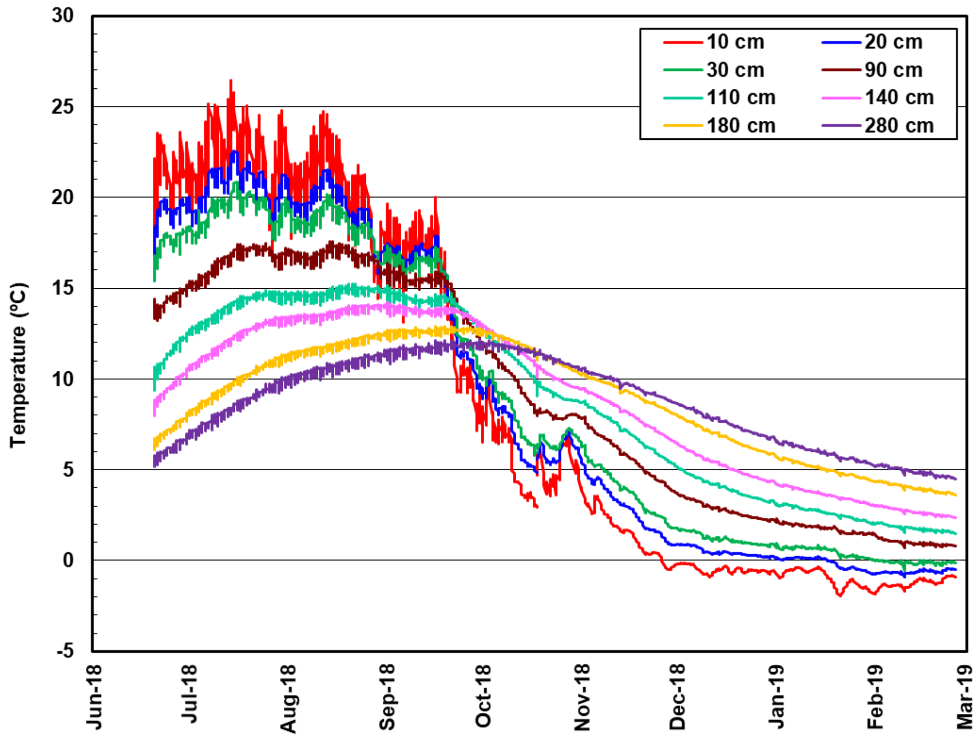

Figure A5: *In situ* soil temperature at Trial #1 Primary Nest.

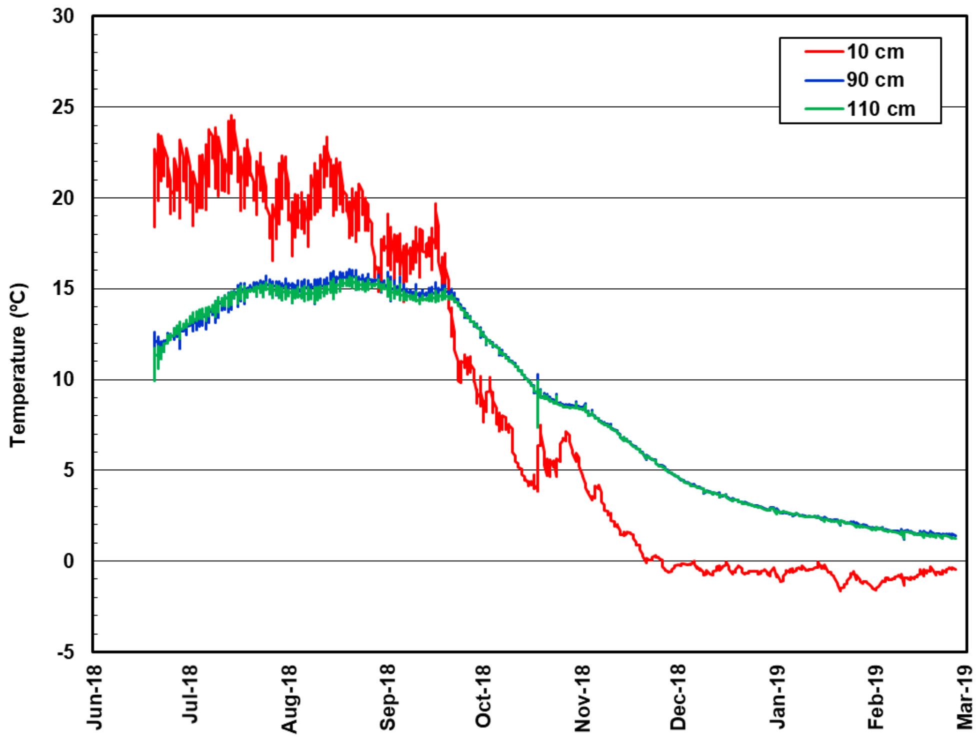

Figure A6: *In situ* soil temperature at Trial #1 Secondary Nest.

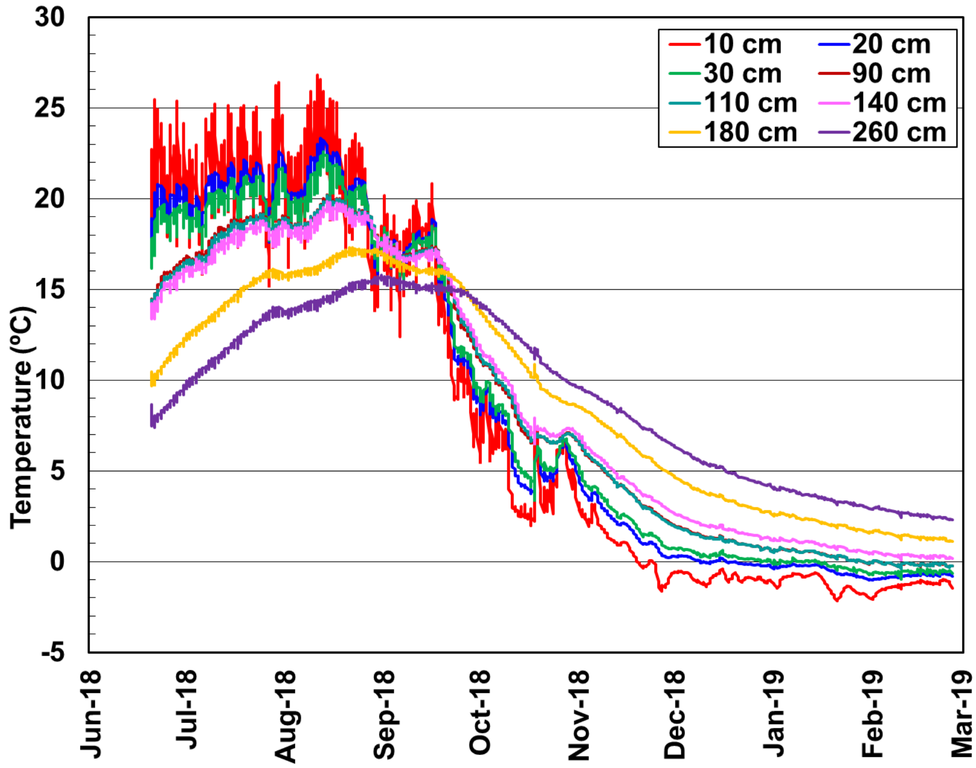

Figure A7: *In situ* soil temperature at Trial #2 Primary Nest.

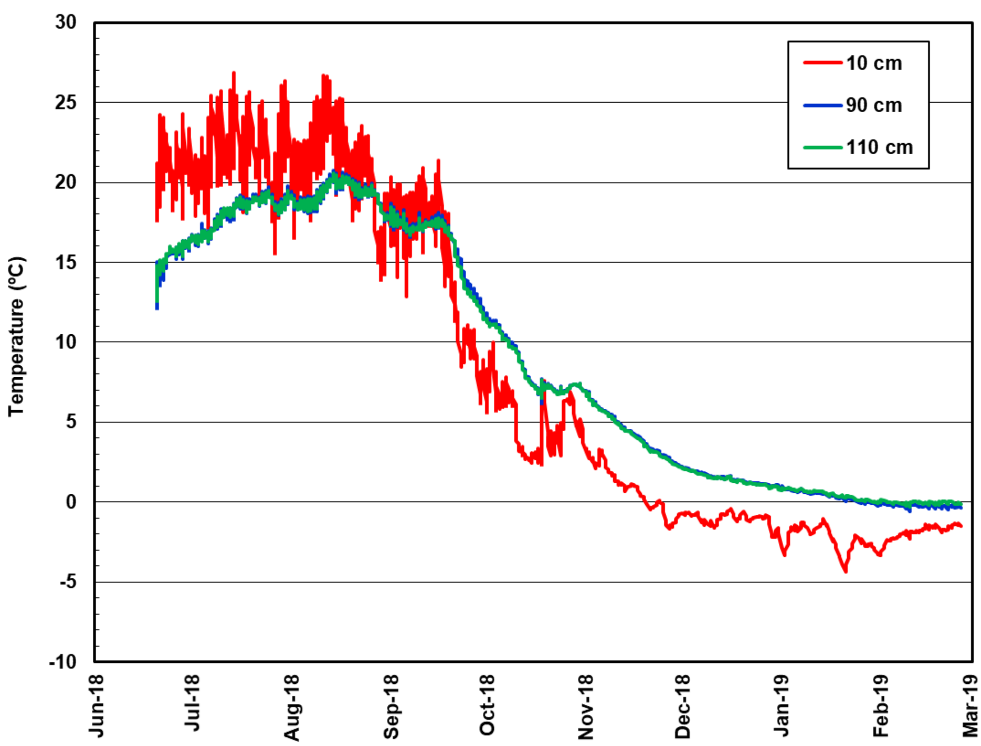

Figure A8: *In situ* soil temperature at Trial #2 Secondary Nest.

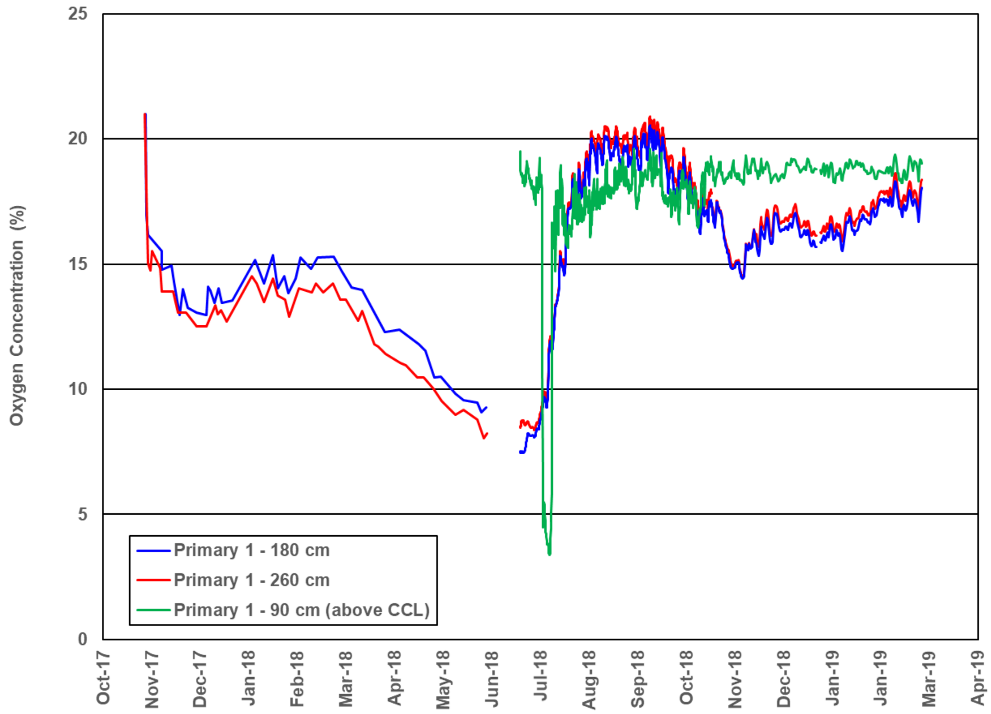

Figure A9: Oxygen concentration at Trial #1 Primary Nest.

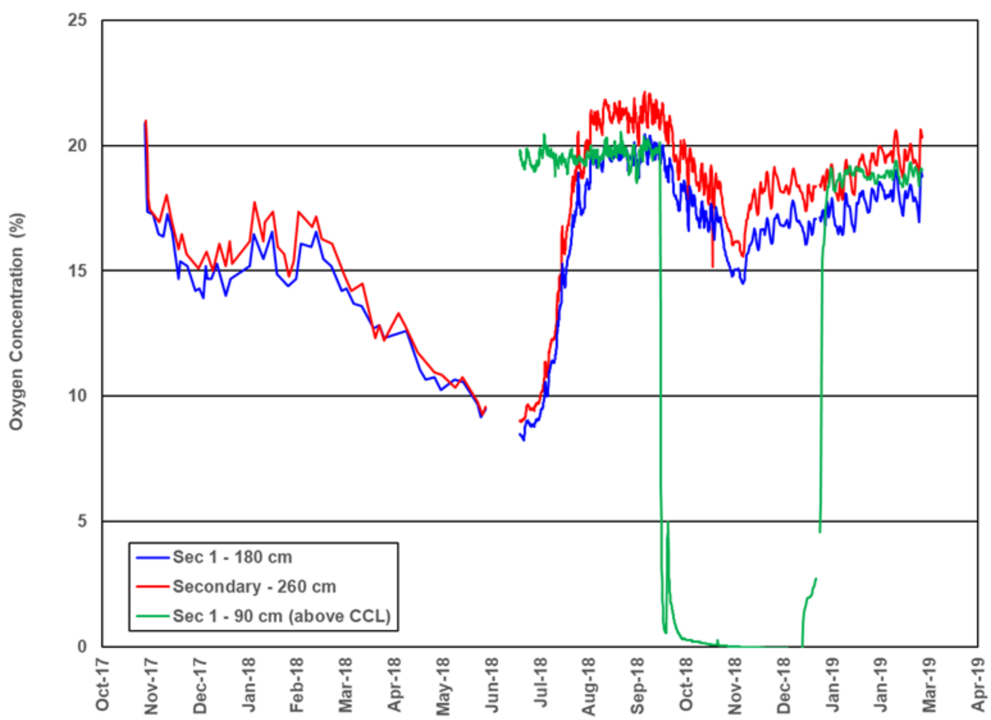

Figure A10: Oxygen concentration at Trial #1 Secondary Nest.

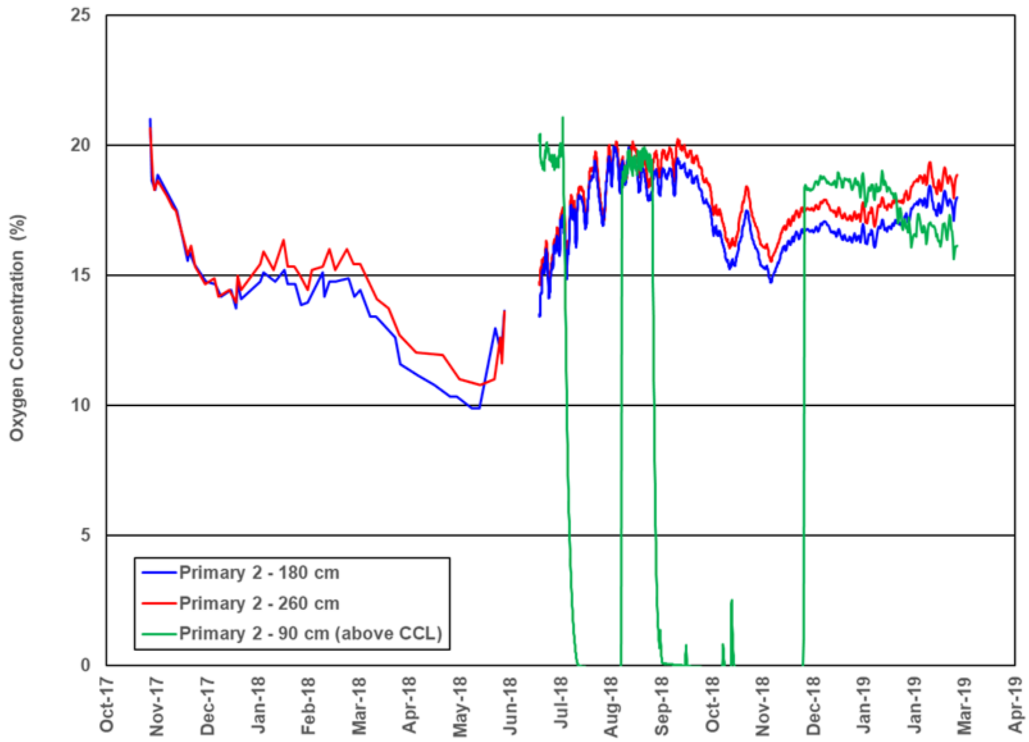

Figure A11: Oxygen concentration at Trial #2 Primary Nest.

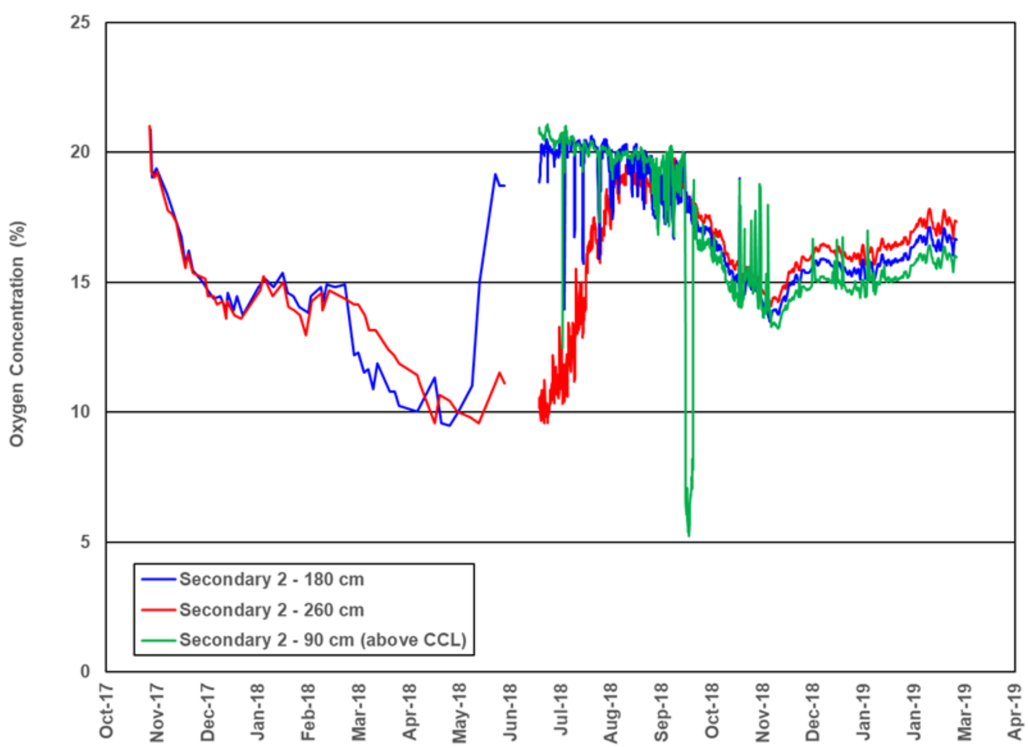

Figure A12: Oxygen concentration at Trial #2 Secondary Nest.